FINAL REPORT

NASA Grant NAG-1-603

Integrated Multidisciplinary Design

Principal Investigators

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CONTRACT SUMMARY

NASA Grant NAG-1-603, 6/20/85 - 1/30/91 has supported research at the Department of Aerospace and Ocean Engineering of the Virginia Polytechnic Institute and State University. The research focused on two major topics: combined aerodynamic - structural design of a transport wing and the control - structural interaction in large space structures. The work has resulted in three M.S. and two Ph.D. degrees, listed below. the major accomplishments of the research are found in the 20 publications listed at the end of this report.

STUDENTS AND DEGREES

William M. Eppard, M.S. (Aerospace Engineering) June 1987.
Thesis: "Integrated Aerodynamic - Structural Design Optimization." Currently Ph.D candidate in Aerospace Engineering at Virginia Polytechnic Institute and State University.

Eva A. Czajkowski, Ph.D. (Aerospace Engineering) June 1987.
Dissertation : "Spillover Stabilization in the Control of Large Flexible Space Structures." currently with ANSER, Inc., Alexandria, VA.

David M. Polen, M.S. (Aerospace Engineering) May 1989.
Thesis: "Integrated Aerodynamic - Structural Design of a Forward-Swept Transport Wing." Currently with Atlantic Research Corporation, Gainesville, VA.

Chris A. Sandridge, Ph.D. (Aerospace Engineering) June 1989.
Dissertation: "Effect of Modal Truncation on Derivative of Closed-Loop Damping Ratios in Structural Control." Currently with Martin Marietta, Denver, CO.

Eric R. Unger, M.S. (Aerospace Engineering) May 1990.
Thesis: "Computational Aspects of the Integrated Multi-Disciplinary Design of a Transport Wing." Currently Ph.D. candidate in Aerospace Engineering at Virginia Polytechnic Institute and State University working on multi-disciplinary aircraft design.

PUBLICATIONS

1. Grossman, B., Strauch, G. J., Eppard, W. M., Gűrdal, Z. and Haftka, R. T., "Integrated Aerodynamic -Structural Design of a Sailpane Wing, " AIAA Paper No. 86-2623, Oct. 1986.

2. Sandridge, C. A. and Haftka, R. T., "Accuracy Derivatives of Control Performance Using a Reduced Structural Model," AIAA Dynamics Specialists Meeting, Monterey, Calif., April, 1987.

3. Czajkowski, E. A. and Preumont, A., "Spillover Stabilization and Decentralized Modal Control of Large Space Structures," AIAA Dynamic Specialists Meeting, Monterey, California, April, 1987.

4. Haftka, R. T., Grossman, G., Eppard, W. M. and Kao, P. J., "Efficient Optimization of Integrated Aerodynamic - Structural Design," Proceedings of 2nd Intl. Conf. on Inverse Design Concepts and Optimization in Engineering Sciences, Oct. 1987, pp. 369-386.

5. Sandridge, C. A. and Haftka, R. T., "Effect on Modal Truncation on Derivatives of Optimal Control Performance," International Conference on Computational Engineering Science, Atlanta, Georgia, April 1988.

6. Czajkowski, E. and Preumont, A., "Spillover Stabilization of Large Space Structures, AIAA Symposium on SDM Issues of the International Space Station, Williamsburg, Virginia, April 21-22, 1988.

7. Preumont, A., Czajkowski, E. and Haftka, R. T., "Stabilizing the Neglected Dynamics in Active Control of Vibration," Third International Conference on Recent Advances in Structural Dynamics, Southampton, England, July 18 - 22, 1988, also, Journal of Guidance, Control and Dynamics, Vol. 13, No. 6, pp. 1000-1007, 1990.

8. Haftka, R. T., Kao, P. J., Grossman, B., Polen, D. and Sobieszczanski-Sobieski, J., "Integrated Structural-Aerodynamic Design Optimization," Proceedings of the 16th Congress of the International Council of Aeronautical Sciences, ICAS-88-1.10R, Aug. 1988, pp. 1820-1825.

9. Haftka, R. T., Grossman, B., Kao, P. J., Polen, D. and Sobieszczanski-Sobieski, J., "Integrated Aerodynamic-Structural Design of a Forward-Swept Transport Wing," Proc. Second NASA/Air Force Symposium on Recent Experiences in Multidisciplinary Analysis and Optimization, Sept. 28-30, 1988.

10. Padula, S. K., Sandridge, C. A., Haftka, R. T. and Walsh, J. L., "Demonstration of Decomposition and Optimization in the design of Experimental Space Systems," Second NASA/Air Force Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, Hampton, Virginia, September 28-30, 1988.

11. Grossman, B., Strauch, G. J., Eppard, W. M., Gűrdal, Z. and Haftka R. T., "Integrated Aerodynamic - Structural Design of a Sailplane Wing," J. Aircraft, 25, No. 9, 1988, pp. 855-860.

12. Haftka, R. T., Grossman, B., Eppard, W. M., Kao, P. J. and Polen, D., "Efficient Optimization of Integrated Aerodynamic - Structural Design," Intl. J. Numerical Methods Eng., 28, 1989, pp. 593-607.

13. Sandridge, C. A. and Haftka, R. T., "Accuracy of Eigenvalue Derivatives from Reduced Order Structural Models," Journal of Guidance, Control and Dynamics, 12, 6, pp. 822-829, 1989.

14. Grossman, B., Haftka, R. T., Kao, P. J., Polen, D. M., Rais-Rohani, M. and Sobieszczanski-Sobieski, J., "Integrated Aerodynamic-Structural Design of a Transport Wing," Paper AIAA-29-2129, AIAA/AHS/ASEE Aircraft Design, Systems and Operations Conference, July 1989.

15. Unger, E. R., Rais-Rohani, M., Hutchison, M. G., Haftka, R. T. and Grossman, B., "Multidisciplinary Design of a Subsonic Transport Wing," Proceedings of the Third Air Force/NASA Symposium On Recent Advances in Multidisciplinary Analysis and Optimization, San Francisco, CA, Sept. 1990.

16. Grossman, B., Haftka, R. T., Kao, P. J., Polen, D. M., Rais-Rohani, M. and Sobieszczanski-Sobieski, J., "Integrated Aerodynamic-Structural design of a Transport Wing," J. Aircraft, 27, No. 12, 1990, pp. 1050-1056.

17. Unger, E. R., Hutchison, M. G., Haftka, R. T. and Grossman, B., "Variable-Complexity Design of a Transport Wing," Proceedings of the II Pan American Congress of Applied Mechanics (PACAM), Valparaiso, Chile, Jan. 1991, pp. 607-610.

18. Unger, E. R., Hutchison, M. G., Haftka, R. T. and Grossman, B., "Variable-Complexity Interdisciplinary Design of a Transport Wing," ICAM Report 91-01-01, Virginia Polytechnic Institute and State University, Blacksburg, VA, Jan. 1991, (to appear in the Int. Journal of Systems Automation: Research and Applications.)

19. Sandridge, C. A. and Haftka, R. T., "Modal Truncation, Ritz, Vectors and Damping-Ratio Derivatives in Structural Control," to be published in Journal of Guidance, Control and Dynamics.

20. Padula, S. L., Sandridge, C. A., Walsh, J. L. and Haftka, R. T., "Integrated Controls-Structures Optimization of Large Space Structures," Proceedings AIAA/ASME/ASCE/AHS/ASC 31st Structures, Structural Dynamics and Materials Conference, Long Beach, CA, April 2-4, 1990.